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Expeditions INDIEN-SUD-1 &2 : Variations of the Antarctic Circumpolar Current (ACC) and of the Austral ocean in the Kerguelen sector during the Deglaciation and the last Climatic Cycles

Alain Mazaud (1), Elisabeth Michel (1), Xavier Crosta (2), Frederique Eynaud (2), Martine Paterne (1), Viviane Bout-Roumazeilles (3), and Samuel Jaccard (4)

(1) Laboratoire des Sciences du Climat et de l'Environnement (LSCE-IPSL), CEA-CNRS-UVSQ, Gif-sur-Yvette, France, (2) Environnements et Paleoenvironnements Oceaniques et Continentaux (EPOC), University Bordeaux1,CNRS-UMR 5805, 33615 Pessac, France, (3) Geosystemes, University Lille I, CNRS-UMR 8717, 59655 Villeneuve d'Ascq, France, (4) Institute of Geological Sciences & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

IndienSud-1 and 2 expeditions aboard the RV Marion-Dufresne were conducted in 2011 and 2012 in the Kerguelen sector of the South Indian Ocean. Objectives are to document past ocean circulation changes, in particular the variations of the Antarctic Circumpolar Current (ACC), as well as oceanic temperature variability and frontal movement, during the last climatic cycles, with a focus on the last deglaciation.
Sedimentary archives collected with the Casq and Calypso coring systems of the RV Marion-Dufresne allow producing high-resolution, well-dated sedimentary records. Comparaisons with exisiting records from other ocean-continental-glaciological archives allow examining the mechanisms involved, with a close attention paid to the temporal phasing between ocean and atmosphere proxy records, at both regional- and hemispheric scales.
Past Changes in the intensity of the ACC are investigated using environmental magnetism methods, which trace amount and size of sedimentary magnetic grains. Oxygen isotopes and foraminifera faunal assemblages trace hydrological and temperature changes, while vertical mixing is documented by δ13C. A precise age scale will be derived from 14C ages determinations, augmented by regional correlations (magnetic susceptibility) to well-dated cores in the same area, thanks to a tephrochronological study of the marine cores and peat cores from the Kerguelen archipelago.

Results document a stronger ACC current during glacial intervals than during interglacials over at least the last 600 kyrs. This pattern is opposite to observations of flow of the NADW branch (WBUC) south of Greenland in the North Atlantic Ocean. It suggests an inter-hemispheric antiphasing between ACC and NADW at Milankovitch timescales, with a strong circulation in the deep North Atlantic when the ACC is weak, and vice versa (thus with an ACC correlated with the GNAIW intensity). During the last deglaciation, temperature and vertical mixing increased prior to changes in the ACC current intensity. A decrease (or northward migration) of the ACC occurred later during the deglacial process. It could be associated to the rate changes of the AMOC and to deep ocean ventilation. Observed changes appear to be closely connected to atmospheric CO_2 changes during the last deglaciation.

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